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UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Thomas William WIELKOPOLSKI
Serial No. : 10/051,210
Filed : January 16, 2002
For : DRIVE SYSTEM
Examiner : Not Assigned
Group Art Unit : Not Assigned

SUBMISSION OF PRIORITY DOCUMENT

Assistant Commissioner for Patents
Washington, DC 20231

Dear Sir:

In accordance with Applicant's Letter re Priority dated November 23, 2001, Applicant submits herewith a Certified Copy of the Priority Document, Italian Patent Application No. FI2000 A 000239, as filed on November 24, 2000.

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Dated: March 13, 2002

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March 13, 2002
Date of Signature

Respectfully submitted,


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The Patent Office

Cardiff Road
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1. Your reference

SMR/MAW/P.73285

2. Patent application number

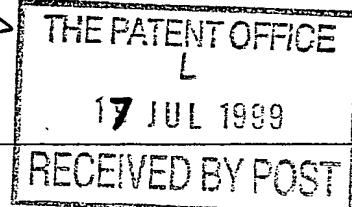
*(The Patent Office will fill in this part)***9916761.1**3. Full name, address and postcode of the or of each applicant *(underline all surnames)*WIELKOPOLSKI, THOMAS WILLIAM
8 SLATER WAY
DUNSTABLE
BEDSPatents ADP number *(if you know it)*

423 844 0003

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

DRIVE SYSTEM

5. Name of your agent *(if you have one)**"Address for service" in the United Kingdom to which all correspondence should be sent
(including the postcode)*URQUHART-DYKES & LORD
MIDSUMMER HOUSE
411C MIDSUMMER BOULEVARD
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6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country

Priority application number
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Number of earlier application

Date of filing
*(day / month / year)*8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

No

- a) *any applicant named in part 3 is not an inventor, or*
- b) *there is an inventor who is not named as an applicant, or*
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Description 4

Claim(s) -

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Statement of inventorship and right -
to grant of a patent (Patents Form 7/77)

Request for preliminary examination -
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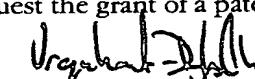
Request for substantive examination -
(Patents Form 10/77)

Any other documents -
(please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature



Date

URQUHART-DYKES & LORD

16.07.99.

12. Name and daytime telephone number of person to contact in the United Kingdom

MR SIMON RAYNOR - 01908.666645

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DRIVE SYSTEM

The present invention relates to a drive system and in particular, but not exclusively, to a drive system for a bicycle. The drive system is also applicable to other human-powered vehicles and mechanisms. The invention also relates to a bicycle having a drive system.

- 5 The drive system used by conventional bicycles consists of a pair of rotating pedal cranks connected by a chain and sprockets to the rear wheel. This system has certain disadvantages. In particular, the tangential force the cyclist is able to exert on the pedals varies considerably according to the positions of the pedal cranks and is at a maximum only when the pedal cranks are approximately horizontal. This limits the efficiency and/or
- 10 maximum power output of the cyclist.

It is an object of the present invention to provide a drive system that mitigates the aforementioned disadvantage. A further object of the present invention is to provide a bicycle having a drive system that enables the cyclist to provide a greater power output and/or to cycle more efficiently.

- 15 According to the present invention there is provided a drive system including at least one lever system having a manually-operable means attached thereto for reciprocating movement, and a drive train connected to the lever system for transferring drive from the manually-operable means.

The manually-operable means is preferably a pedal but may alternatively be a handle.

- 20 The drive system preferably includes two lever systems, which are preferably interconnected for opposed reciprocating movement.

The lever system preferably includes a first lever having a first end that is connected to a first fixed pivot and a second end that is rotatable about the first fixed pivot, a second lever having a first end that is pivotably connected to the second end of the first lever and a

- 25 second end to which the manually-operable means is attached, and a tie rod having a first end that is pivotably connected to a second fixed pivot and a second end that is pivotably connected to the second lever between the first and second ends thereof.

The drive train preferably includes a hydraulic drive train but it may alternatively be entirely mechanical.

The hydraulic drive train preferably includes a hydraulic drive cylinder having a first end that is connected to a pivot point and a second end that is connected to the first lever between

5 the first and second ends thereof, for actuation by pivoting movement of the first lever.

The first end of the hydraulic drive cylinder is preferably connected to a movable pivot point that can be moved to adjust the stroke length of the cylinder. A hydraulic adjuster may be provided for adjusting the position of the movable pivot point.

The present invention further provides a bicycle having a drive system as described in the
10 preceding paragraphs.

The bicycle may include a hydraulic drive train including at least one hydraulic motor for driving the rear wheel, the front wheel or both wheels of the bicycle. The bicycle may include a plurality of hydraulic motors that can be connected into the hydraulic circuit individually, in series or in parallel to adjust the gearing effect of the drive system.

15 An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is side view of the drive system;

Fig. 2 is a side view of a bicycle having a drive system as shown in Fig. 1, and

Fig. 3 is a hydraulic circuit diagram of a hydraulic drive train for use with the drive system.

20 The invention relates to a drive system for bicycles or other pedal driven mechanisms. The system includes a first arm 1 and a second arm 2, which are attached to the bicycle frame 3 at their upper ends through first and second pivots 4,5. A lever 6 is attached to the lower ends of the first and second arms through third and fourth pivots 7,8, the third pivot 7 being located at one end of the lever 6 and the fourth pivot 8 being located between the ends of
25 the lever, close to the third pivot 7. A pedal 9 is attached to the free end of the lever 6, the arrangement being such that the pedal can move up and down substantially linearly, as

indicated by the arrow labelled "down". All these items may be duplicated in a symmetrical fashion for a second pedal.

The first arm 1 is attached to a drive train to turn the wheels or drive the mechanism. In a preferred arrangement of the design the drive train consists of a hydraulic drive cylinder 10, 5 which is attached at its lower end to a pivot 11 on the first arm 1, located between its ends. The hydraulic drive cylinder 10 is attached at its upper end to the frame 3 and a hydraulic adjuster 12. The hydraulic adjuster 12 is also attached to the frame 3 through a pivot 13 and may be actuated to adjust the position of the upper end of the drive cylinder relative to the frame. The hydraulic drive cylinder pumps oil around a hydraulic system. This system, 10 which is shown in Fig. 3, has an oil reservoir 15 and a regulation system and a control system 16 and one or more hydraulic motors 17.

When a pressure is exerted on the pedal 9 the lever 6 moves in the direction labelled "down" and rotates around pivot 7 and the reaction through the second arm 2 forces the first arm 1 to rotate around pivot 4, driving the hydraulic drive cylinder 10, which is arranged to 15 pump oil around the hydraulic system. When the pedal 9 reaches the end of possible movement it is so arranged to return to the start position at the opposite end of its range of movement. In so doing the hydraulic drive cylinder 10 is refilled with fluid and the cycle starts again. The components are so arranged that movement of the hydraulic adjuster 12 has the effect of varying the amount of oil pumped around the system, thereby providing a 20 continuously (i.e. steplessly) variable gearing system. The adjuster may be arranged in such a way that the fluid in the drive system operates the adjuster so providing automatic adjustment of the gear ratios. Both sides may be connected together to ensure that the pedals move in opposite directions.

The hydraulic circuit may be arranged as shown in the diagram included here for clarity only. 25 Fluid is drawn from the reservoir 15 through a one way valve 18 to the hydraulic cylinder 10 and pumped under pressure through another one way valve 19 to a control valve 16 and so through motors 17 as required then returning to the reservoir. A small amount of fluid is passed into a control system 20 to actuate the adjuster 12.

In alternative arrangements, the hydraulic components may be replaced by a gear, shaft or chain drive. In these arrangements provision will be made for relative movement of the pivots to provide a range of gear ratios.

The constituent parts are so arranged that the movement of the pedal and output is in 5 relation to the force that can be exerted on the pedal. There is no point in the cycle that a full force cannot be output by the system. By aligning the direction of pedal movement with the input force the system makes more efficient use of the work energy available.

Various modifications of the drive system are possible. For example, the drive cylinder may be connected to the second arm instead of the first arm; the lever to which the pedal is 10 attached may be curved rather than straight; and the whole mechanism may be oriented differently, for example when it is advantageous for the person operating the drive system to adopt a reclined position.

tom FRAME 1 JUNE 10, 1999 21.07.53

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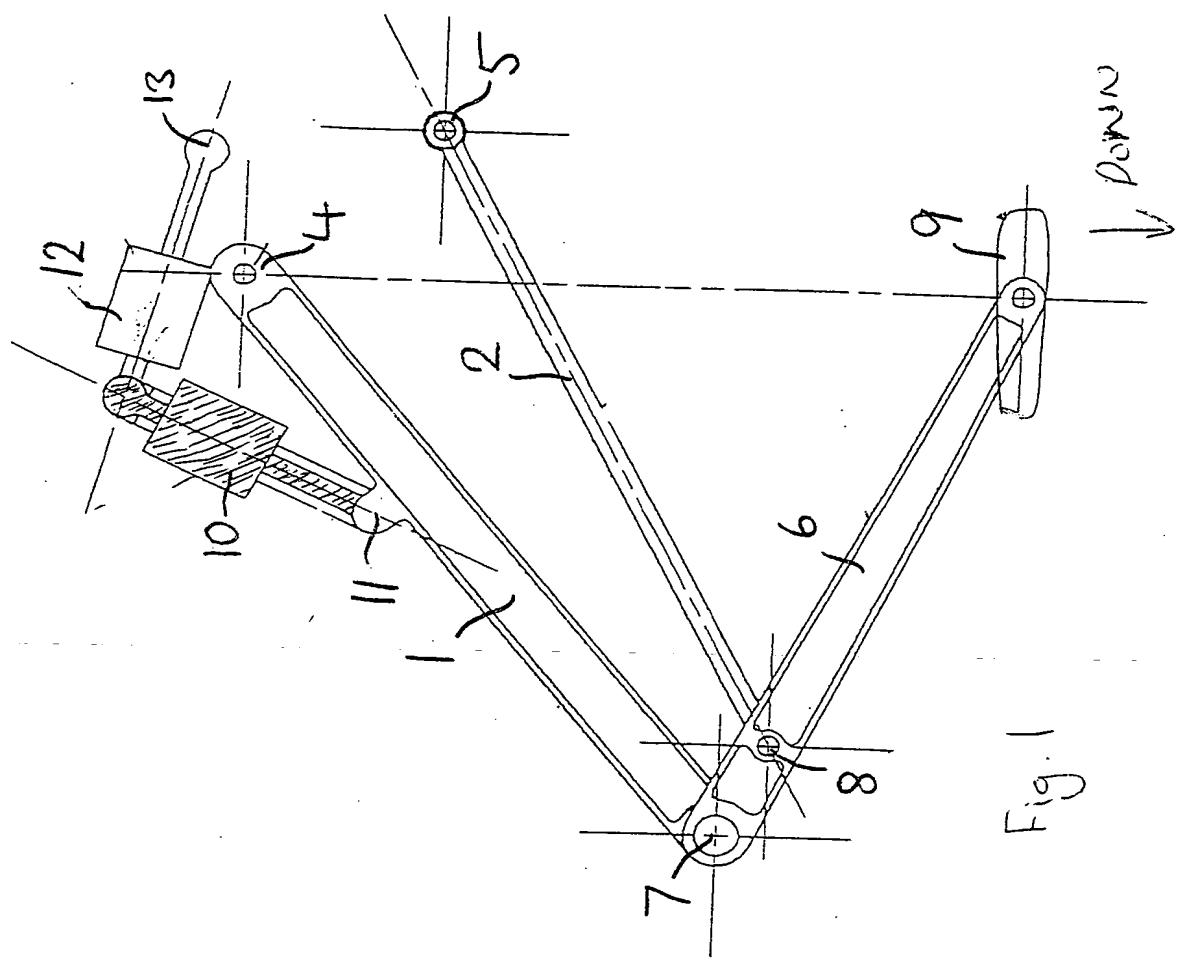


Fig. 1

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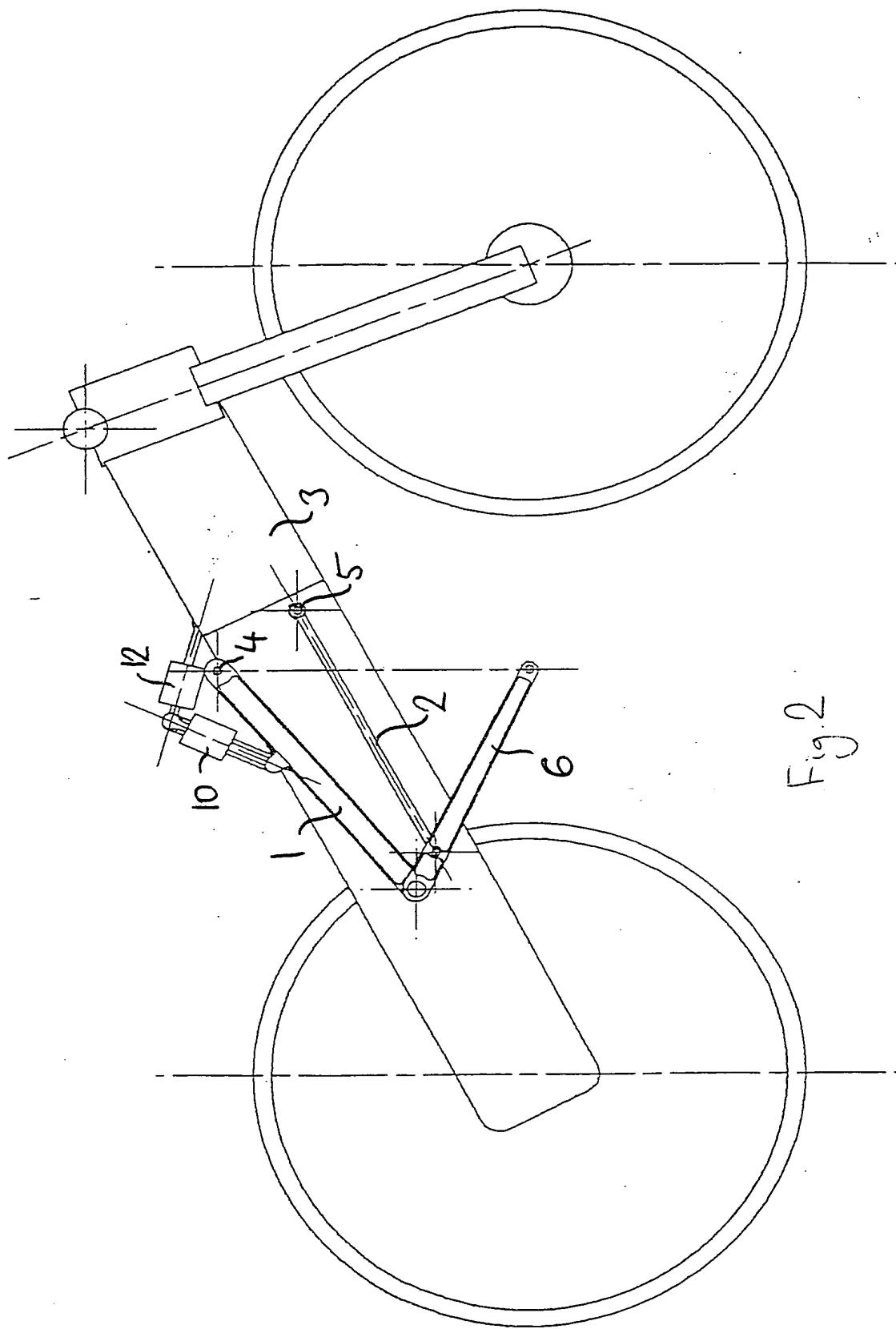


Fig. 2

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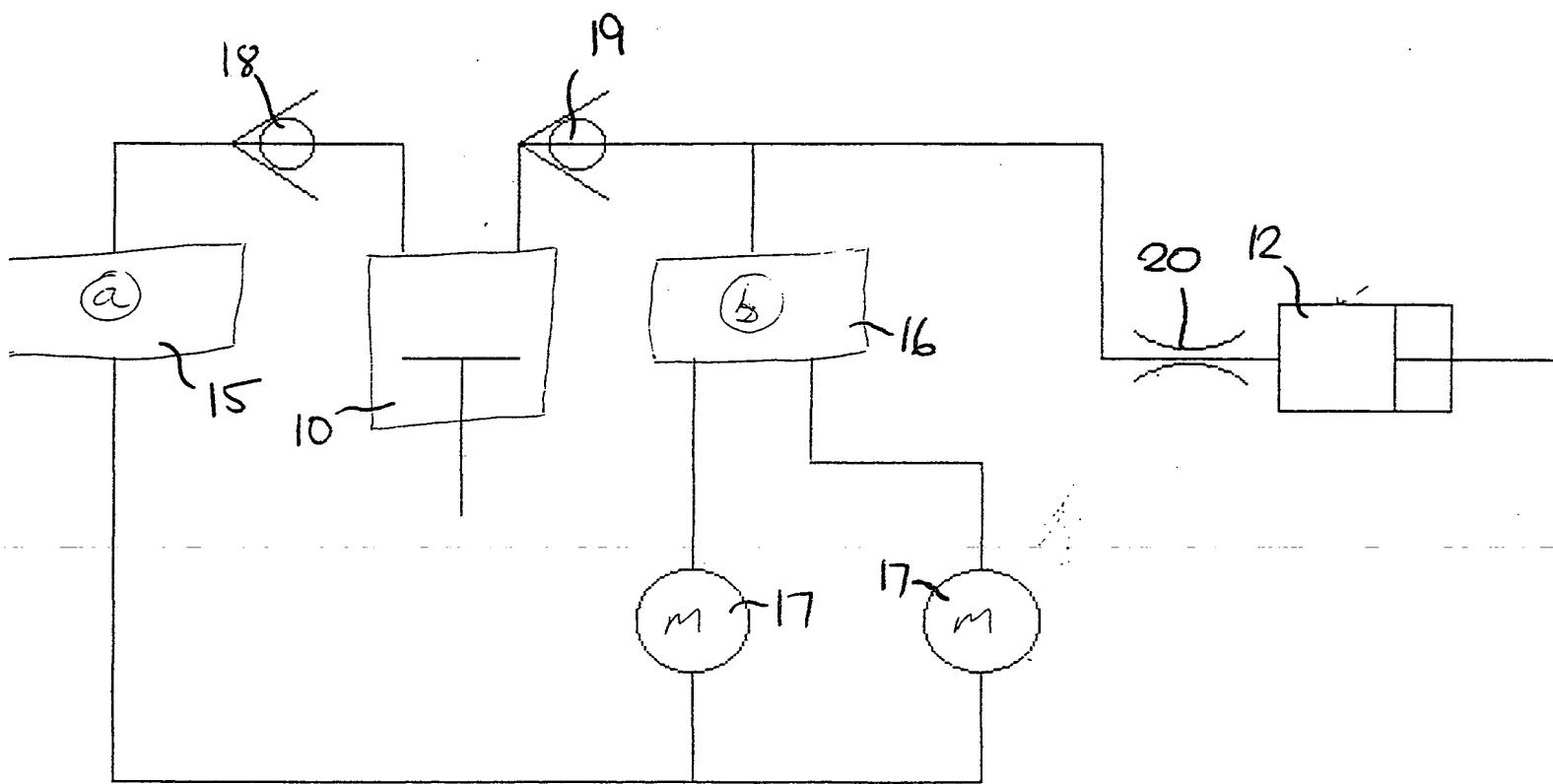


Fig. 3

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